THURSDAY, OCTOBER 30, 1913.

RADIATION THEORIES.

Vorlesungen über die Theorie der Wärmestrahlung. By Dr. Max Planck. Zweite Auflage. Pp. xii+206. (Leipzig: J. A. Barth, 1913.) Price 7 marks.

THE first edition of this book, which appeared in 1906, was reviewed in NATURE (October 11, 1906, Supplement iii.). The many and varied contributions to our knowledge of radiation phenomena that have been published in the ensuing seven years have made it necessary for Dr. Planck to rewrite and modify the book to a considerable extent, so that it now contains many novel features. As before, the object of the book is to apply the statistical methods previously used in the kinetic theory of gases to the phenomena of radiation, and full use is made of Boltzmann's views on the interpretation of entropy in connection with the theory of probability. But the present treatment is largely based on the remarkable assumption which the author designates as the "quantum-hypothesis."

The property thus assumed for the elementary electrical oscillators under consideration may perhaps best be explained by comparing them to the cisterns, of which many have been invented and which are so arranged that when the water in them reaches a certain level they overturn and empty themselves, then returning to their original position to be refilled. In other words, absorption takes place continuously, while emission occurs intermittently when the energy of the oscillator attains one or other of certain discrete values. This "quantum hypothesis," as the author points out, is analogous to the electron theory, which assigns a definite magnitude to the electron or "elementary quantum" of electricity. It accounts for Nernst's observed phenomena, and, further, it is in accordance with the view that every different radiation corresponds to a certain definite temperature, and it is already beginning to form an important element in present-day physical researches.

It need scarcely be pointed out that the quantum hypothesis entails irreversibility and thus overcomes a difficulty of the kinetic theory of gases, namely, that even statistical methods apparently fail to account for irreversible phenomena when applied to a system the elements of which are subject to the equations of reversible dynamics, unless some further assumption is made ("Assumption A" of the late Mr. Burbury). It will thus be seen that the present method does not pretend to afford a so-called "dynamical proof" of the phenomena of radiation, and in the preface Dr. Planck distinctly expresses the view that a new principle cannot in general be represented by a model working according to old laws. It will also be evident that brief indications of the new method, such as those contained in this notice, cannot be regarded as adequate descriptions of the real substance of Dr. Planck's investigations.

It was natural that a theory fraught with such far-reaching consequences should attract considerable attention at the recent meeting of the British Association, and the occasion was the more suitable as the presidency of Sir Oliver Lodge had attracted to the meeting a number of physicists all keenly interested in radiation theories. It would be undesirable to refer in greater length to these discussions, as they will be dealt with elsewhere. A popular account of modern radiation theories, including special reference to Dr. Plancks quantum hypothesis, was given by Dr. Max Born, of Gottingen, in *Die Naturwissenschaften* 21, for May 28, p. 499.

It does not appear to the present reviewer that the quantum hypothesis is necessarily irreconcilable with dynamical principles. If we take the equations of motion of a dynamical system and write down the expressions for the second differential coefficients of the squares and products of its velocities, we obtain formulæ which may be said to determine the energy accelerations of the system in the same way that the ordinary equations of motion determine the accelerations of the masses. If we assume conditions of statistical equilibrium we find a definite amount of energy associated with a definite system, and we further find that certain conditions must hold in order that energy equilibrium may be possible. Such a method establishes a kind of principle of duality between the properties of matter and the properties of energy, and is distinctly favourable to an atomic theory of energy. But the attempt to reduce everything to dynamics would of course land us in the old difficulty over the irreversibility.

G. H. B.

CHEMICAL TEXT-BOOKS.

(1) *Osmotic Pressure.* By Prof. A. Findlay. Pp. vi+84. (London: Longmans, Green & Co., 1913.) Price 2*s.* 6*d.* net.

(2) *The Organometallic Compounds of Zinc and Magnesium.* By Dr. Henry Wren. Pp. viii+100. (London: Gurney and Jackson, 1913.) Price 1*s.* 6*d.* net.

(3) *The Chemistry of Dyeing.* By Dr. J. K. Wood. Pp. vii+80. (London: Gurney and Jackson, 1913.) Price 1*s.* 6*d.* net.

(4) *V. v. Richter's Chemie der Kohlenstoffverbindungen oder organische Chemie.* Elfte Auflage. Zweiter Band. Carbocyclische und heterocyclische Verbindungen. Neu bearbeitet von Dr. Richard Anschutz. In Gemeinschaft mit Dr. Hans Meerwein. Pp xxii+1048. (Bonn: Friedrich Cohen, 1913.) Price 26 marks.

(5) *Traité Complet d'Analyse Chimique Appliquée aux Essais Industriels.* By Prof. J. Post and Prof. B. Neumann. Deuxième Edition Française Entièrement Refondue par G. Chenu et M. Pellet. Tome Troisième. Second Fascicule. Pp. 465-903+v. (Paris: A. Hermann et Fils, 1913.) Price 15 francs.

(6) *Traité de Chimie Minérale.* By H. Erdmann. Ouvrage traduit sur la 5e édition allemande par Prof. A. Corvisy. Tome Premier. Introduction à la Chimie et Métalloïdes. Pp. iv+559. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

(7) *Laboratory Text-Book of Chemistry.* By V. Seymour Bryant. Part 1. Pp. vi+246. (London: J. and A. Churchill, 1913.) Price 4*s.* net.

(1) THOSE who have read Dr. Findlay's book on the phase rule will have formed great expectations of his promised monograph on osmotic pressure, and we believe they will not be disappointed. The expression osmotic pressure of a solution has become a familiar one both to chemists and biologists, though, as Dr. Findlay is careful to point out, it is incorrect. A solution does not in itself have any osmotic pressure, the term being loosely used to denote the mechanical pressure *which would be produced* if the solution were separated from the pure solvent by a membrane which was permeable only to the solvent. The confusion of thought which has arisen in connection with the subject, especially amongst the biologists, is unfortunately very considerable, so that Dr. Findlay's clear treatise comes at an opportune moment and should be widely read. Although necessarily mathematical in parts, it is not unduly so, even for the biological reader.

The author shows himself to be no bigot in favour of the extreme views of the German physical-chemical school, and his chapter on the cause of osmosis and the action of the semipermeable membrane reaches a high standard. Regarded from the biological side, the subject of osmosis is one in which we are on the eve of important developments requiring interpretation in the broadest possible manner. In the past the tendency has been to give too little attention to the chemical meaning of the osmotic phenomena, but this error is avoided in the present work.

The work of Lord Berkeley in this country and that by Morse in America is described at length and its bearing on the general theory of ideal solutions discussed in a separate chapter. Emphasis is laid on the thermodynamic equation connecting the osmotic pressure with the vapour pressure of solutions.

(2), (3) Chemical monographs are evidently fashionable, and the success of the biochemical series edited by Dr. Plimmer and the inorganic series for which Dr. Findlay is responsible has inspired others to imitate them. The new series for which Dr. Cumming is sponsor are, however, of a different type and can scarcely lay claim to the title monograph—indeed, the use of the term is misleading. They are essentially summaries intended for advanced students with the examination bugbear in front of them, and though no doubt they will be very useful, they are in no way authoritative in the same sense as the other monographs to which reference has been made. However, they are well printed and convenient in size and price, and should prove very popular among students.

No. 1 in the series is Dr. Wren's essay on the organometallic compounds of zinc and magnesium. Though Grignard described the reaction which now bears his name so recently as 1900, the method has proved so fruitful in effecting organic syntheses that their number is already legion, and the subject forms, we fear, a very favourite examination question—hence, no doubt, the motive and form of the present summary. The mode of using the reagent is first described, but the bulk of the book is devoted to the description, with copious formulæ, of the products formed by its aid. A few pages are devoted to the theory of the reaction. The final section deals with Blaise's more recent applications of the organometallic derivatives of zinc, which afford reagents of less general activity and of greater ease of control.

Dr. Wood's summary of the chemistry of dyeing is simply and clearly written and devoid of technical terms, so that it should appeal to a wider public than the chemical student and, indeed, be in the hands of all practical dyers. The scheme followed is first to discuss the chemical composition and properties of the textile fibres, then to deal with the classification and properties of dyes, and lastly with the nature of the dyeing processes. A small bibliography and index is attached. The author is to be congratulated on the clear way in which he has dealt with the rival theories of dyeing within a short space.

(4) A new edition of Richter scarcely calls for criticism beyond the statement that the authors have maintained the standard of a work which has been indispensable to all students of organic

chemistry in the past and is likely to prove equally valuable to all in the future. No other text-book is so exhaustive and yet relatively still readable. We have taken the opportunity to test it somewhat severely and always found the desired information. The new edition does, however, afford an opportunity of noting the enormous increase in our knowledge of this part of organic chemistry—embracing the carbocyclic and heterocyclic compounds. Our former copy of the ninth edition, bearing the date 1901, is a modest little work of 809 pages, measuring 4 × 6 inches. The new edition requires 1048 pages, measuring 4½ × 7 inches.

Even in 1900 the would-be chemist made some attempt to master the whole of Richter—to-day this is obviously impossible, and the student is forced to specialise at an early stage in his reading. Fortunately, chemical literature is now enriched by very many special monographs of a very readable character and free from too much elaboration of detail. When these are supplemented by Richter—the encyclopædia of chemistry—the student is indeed well armed. We have one suggestion only—namely, the author's name, as well as the journal reference, should be quoted in the references to the original literature. The omission of the author's name prevents reference to the abstracts of the original in the Journal of the Chemical Society or in the *Centralblatt* when the original paper itself is not available.

(5), (6) These translations of well-known standard German works testify to the rank taken by German science in other lands: they are already well known in this country. The second part of vol. iii. of Prof. Neumann's technical analysis contains Schultz's famous monograph on coal tar and artificial colouring matters, which already has a world-wide reputation and forms an appropriate complement to Germany's most famous chemical industry. This is the second French edition translated from the third German edition of the work.

Prof. Corvisy's book is a translation for the first time of the fifth German edition of the first volume of Erdmann's well-known work. The translator refers to the need of such a work in France, where no other book is available for students covering the ground in quite the same way.

(7) This book is intended to be actually used as a laboratory note-book in schools, the pupil having to write his answers in the spaces in the text left for the purpose. Precise instructions are given how to do everything and what to observe and infer, and in quantitative exercises only the actual figures have to be filled in by the schoolboy. The book is elaborately bound and somewhat expensive. We fear we do not agree with the author's interpretation of practical chemistry; indeed, we had hoped that books of this type had ceased to exist.

E. F. A.

PROBLEMS OF LIFE AND REALITY.

(1) *Essais de Synthèse Scientifique.* By E. Rignano. Pp. xxi + 294. (Paris: F. Alcan, 1912.) Price 5 francs.

(2) *Contre la Métaphysique.* By F. Le Dantec. Pp. 255. (Paris: F. Alcan, 1912.) Price 3 francs 75 centimes.

(3) *Modern Science and the Illusions of Prof. Bergson.* By H. S. R. Elliot. With a preface by Sir Ray Lankester, K.C.B., F.R.S. Pp. xix + 257. (London: Longmans, Green and Co., 1912.) Price 5*s.* net.

(4) *Wissenschaft und Wirklichkeit.* By Max Frischeisen-Köhler. Pp. viii + 478. (Berlin: B. G. Teubner, 1912.) Price 8 marks.

(5) *The Young Nietzsche.* By Frau Förster-Nietzsche Translated by A. M. Ludovici. Pp. viii + 399. (London: W. Heinemann, 1912.) Price 15*s.* net.

THE first two of these volumes contain a curiously similar plea for the theorist in science. M. Rignano in his opening essay (1) maintains that there are a number of central problems in the biological sciences, in which there is almost a deadlock, due to the fact that they have been attacked exclusively by two opposite groups of specialists. One such problem, awaiting the synthetic view, is that of the nature of life and growth. Others are: the meaning of religion as viewed from the psychological and the sociological points of view; the economic and ideologic factors in history; the antithesis of socialism and liberal economics. These are dealt with in successive essays. In the first the various transformist theories are reviewed, in order to demonstrate how far-reaching may be the clarifying effects of a single piece of theorising. At the same time the *leit-motiv* of the whole volume is introduced—the mnemonic principle. The recapitulation of phylogenetic development in ontogenesis is essentially mnemonic, as is assimilation.

The same principle is next applied more in detail to the problem of growth, by means of a summary of the author's "centro-epigenetic" theory of development. This asserts that growth is determined by a nervous circulation, independent of a nervous system, consisting of discharges of specific nervous energy accumulated in the germ-plasm, each discharge depositing a substance apt in decomposing to regenerate the same